

8. CONTAMINATED SOIL SITES CFA-04, CFA-08, AND CFA-10

Remedial actions are required for three soil sites: (1) the CFA-04 Pond, (2) the CFA-08 Drainfield, and (3) the CFA-10 Transformer Yard site. Sections 8.1 through 8.3 address each of the sites, including the nature and extent of contamination and BRA results. More detailed information about the contaminated soil sites may be found in the OU 4-13 RI/FS report (DOE-ID 1999a).

8.1 CFA-04 Pond (OU 4-05)

The CFA-04 pond will be remediated to address the threat to human health and ecological receptors from mercury in soil. A summary of the site history, site investigations, nature and extent of contamination and estimated risks are presented below.

The CFA-04 Pond is a shallow, unlined surface depression that was originally a borrow pit for construction activities at the CFA. It is approximately 152 × 46 m (500 × 150 ft) and roughly 2 to 2.4 m (7 to 8 ft) deep; basalt outcrops are present within and immediately adjacent to the pond. It received laboratory wastes from the Chemical Engineering Laboratory (CEL) in Building CFA-674 between 1953 and 1969. The CEL was used to conduct calcine experiments on simulated nuclear wastes. (The calcining process was later used on actual nuclear wastes at the INEEL to change them from a liquid to a solid and to effect an overall volume reduction.) The CEL experiments used mercury to dissolve simulated aluminum fuel cladding as well as radioisotope tracers in the calcining process. The primary waste streams discharged to the pond from the CEL included approximately 76.5 m³ (100 yd³) of mercury-contaminated calcine that contained low-level radioactive wastes and liquid effluent from the laboratory experiments. Additionally, there is approximately 382 m³ (500 yd³) of rubble, consisting of laboratory bottles, asphalt and asbestos roofing materials, reinforced concrete and construction and demolition debris. The pond received runoff from the CFA site periodically between 1953 and 1995.

8.1.1 Site Investigations

The CFA-04 Pond was identified as a Track 2 investigation site in the FFA/CO (DOE-ID 1991). Visual inspections in 1994 revealed the presence of calcine on the bermed areas around the periphery of the pond. Following surface and subsurface soil data collection from the calcine and the pond berm in early and mid-1994, a time-critical removal action in September 1994 excavated approximately 218 m³ (285 yd³) of calcine and calcine-contaminated soil and a small amount of asbestos from the bermed area. The soil was remediated at a portable retort set up northeast of the pond. Verification soil sampling conducted after the removal action showed that the bermed areas had residual mercury concentrations up to 233 mg/kg (DOE-ID 1999a).

During the 1995 Track 2 investigation, additional soil samples were collected from the pond inlet area as well as a deeper area of the pond near the inlet where laboratory effluent may have collected. The results of the 1994 and 1995 soil investigations revealed that concentrations of the following constituents exceeded background concentrations for the INEEL: aluminum, arsenic, barium, cadmium, calcium, chromium, cobalt, lead, magnesium, mercury, nickel, cesium-137, palladium-234m, strontium-90, thorium-234, uranium-234, uranium-235 and uranium-238. Aroclor-1254 was also detected at low levels. Preliminary risk screening indicated that the following constituents detected at the pond posed potential human health risks: aroclor-1254, arsenic, mercury, cesium-137, uranium-234, uranium-235, and uranium-238. On this basis, the site was recommended for further characterization in the OU 4-13 RI/FS (INEEL 1996b).

Additional soil samples were collected for the OU 4-13 RI/FS during 1997 and 1998 at four areas

along the length of the pipe connecting the CEL to the pond, in the area northeast of the pond known as the windblown area, and from the pond bottom. Data from these investigations confirmed the presence of mercury in these areas at concentrations up to 439 mg/kg (DOE-ID 1999a). Four of 88 samples exceeded the mercury RCRA characteristic hazardous waste level of 0.2 mg/L. Three of the four samples were in close proximity to one another in the pond and the fourth was an isolated occurrence in the windblown area and was eliminated. A contour line was drawn around the three closely spaced samples and the area was estimated. The depth of soil in the pond was conservatively estimated to be 2.4 m (8 ft) in the pond bottom and 0.15 m (0.5 ft) in the wind blown area, indicating that approximately 612 m³ (800 yd³) of soil is potentially characteristic waste per RCRA and is subject to Land Disposal Restrictions upon excavation.

8.1.2 Nature and Extent of Contamination

The only contaminant that poses an unacceptable risk to human health and the environment is mercury. Mercury-contaminated soil is present in the pond bottom, around the pond periphery in the berms, along the pipe connecting the CEL to the pond, and in the area northeast of the pond as a result of windblown contamination, an area encompassing approximately 183 × 91 m (600 × 300 ft) (Figure 8-1). The OU 4-13 RI/FS conservatively estimated the volume of mercury-contaminated soil to be approximately 6,338 m³ (8,290 yd³), based on the dimensions of the pond bottoms, wind blown area and pipeline at depths of 2.4 m (8 ft), 0.15 m (0.5 ft), and 1.8m (6 ft) respectively.

8.1.3 Summary of Site Risks

The CFA-04 Pond was retained for quantitative risk analysis in the OU 4-13 RI/FS to evaluate human health risks from aroclor-1254, arsenic, mercury, cesium-137, Ra-226, U-234, U-235, U-238; and ecological risks from arsenic, barium, cadmium, chromium-III, cobalt, copper, lead, mercury, nickel, nitrate, silver and vanadium. Refer to the OU 4-13 RI/FS (DOE 1999a) for the details of the risk assessment process.

8.1.3.1 Human Health Risk Assessment. Mercury was identified as the only contaminant that poses an unacceptable risk to human health at CFA-04 with a noncarcinogenic HQ of 80. Table 8-1 summarizes the data for mercury at the CFA-04 Pond.

The estimated total risk for the current and future occupational worker is less than 1E-04. The noncarcinogenic hazard index for both current and future occupational scenarios is less than 1.

The total excess cancer risk, from the BRA, for the future residential scenario is 4E-05 (4 in 100,000). The estimated HQ for future residential scenario is 80. The majority of the noncancer risk is from mercury (97%) and the exposure route is ingestion of homegrown produce.

8.1.3.2 Ecological Risk Assessment. Mercury is the only contaminant that poses an unacceptable risk to ecological receptors. The maximum concentration of 439 mg/kg results in a hazard quotient of 30,000 (DOE-ID 1999a).

Table 8-1. Summary data for the human health and ecological COC at the CFA-04 Pond.

Contaminant of Concern	Units	Number of Samples	Number of Detections	Minimum Detected	Maximum Detected	Exposure Point Concentration	INEEL Background Concentration ^a
Human Health							
Mercury	mg/kg	267	247	0.9	439	146 ^b	0.05
Ecology							
Mercury	mg/kg	267	247	0.9	439	439 ^c	0.05

a. The background value for composited samples from INEEL 1996a.

b. Volume weighted average 95% UCL concentration.

c. Maximum concentration detected.

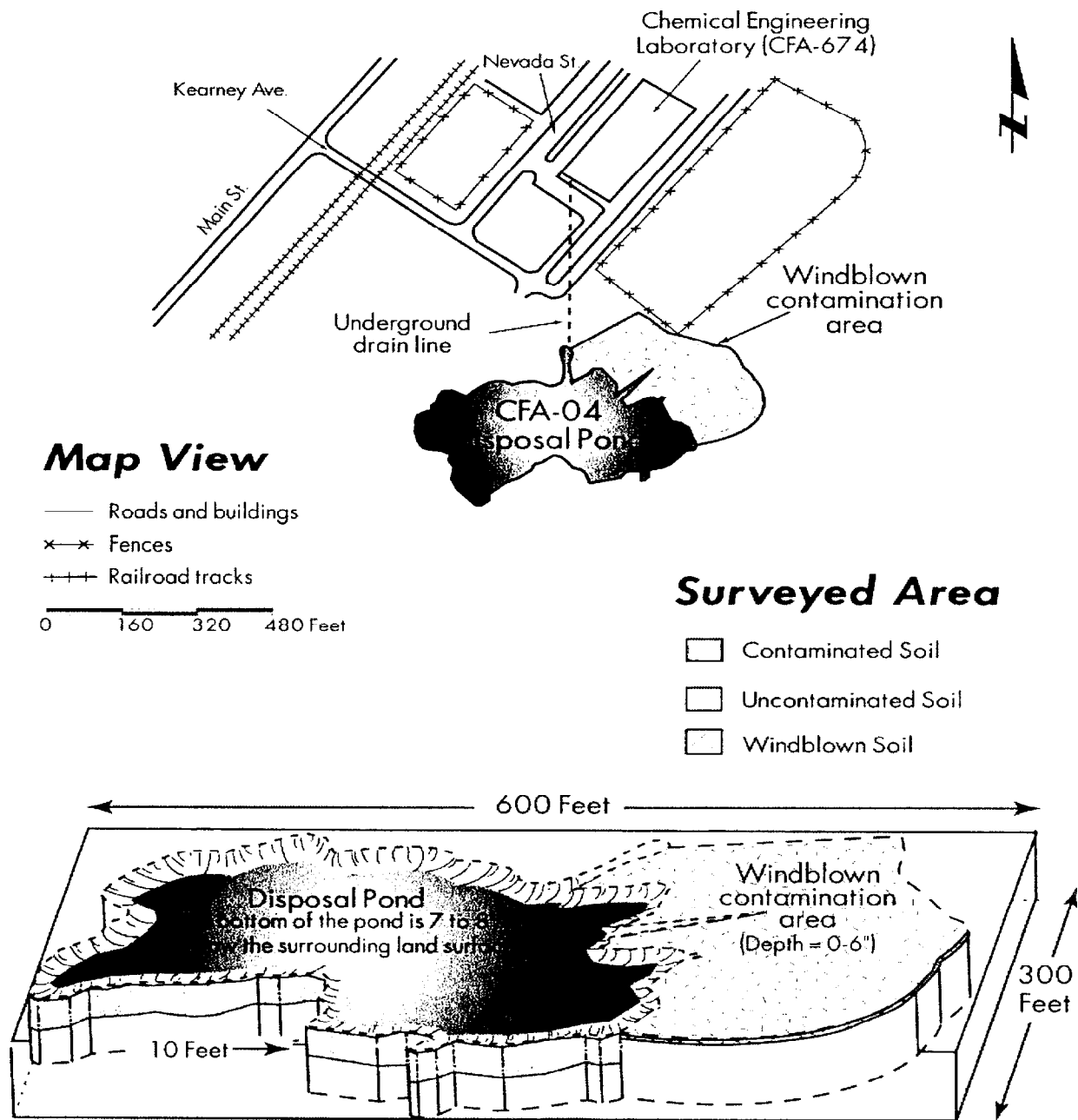


Figure 8-1. Pond (CFA-04).

8.2 CFA-08 Sewage Plant Drainfield (OU 4-08)

The CFA-08 (SP) Drainfield will be remediated to address the threat to human health from external radiological exposure from cesium-137 in soil. A summary of the site history, site investigations, nature and extent of contamination, and estimated risks are presented in this subsection.

The Navy first operated a sewage treatment facility at CFA from 1944 through 1953. This system consisted of a septic tank (CFA-716), a sludge drying bed, and two distribution areas. In 1953, a new system was constructed that utilized the original septic tank, a new sludge drying bed, and an expanded drainfield with additional distribution areas equipped with trickling filters, digesters, and two clarifiers. This system operated, with some modifications, until February 1995. It received effluent from sewage waste lines from chemical laboratories, craft shops, warehouses, photographic services, vehicle services, a medical dispensary, a maintenance repair shop and laundry facilities that processed low-level radiologically contaminated clothing. Average flow through the SP ranged between 416,350 L (110,000 gal) to 662,375 L (175,000 gal)/day (INEEL 1995c).

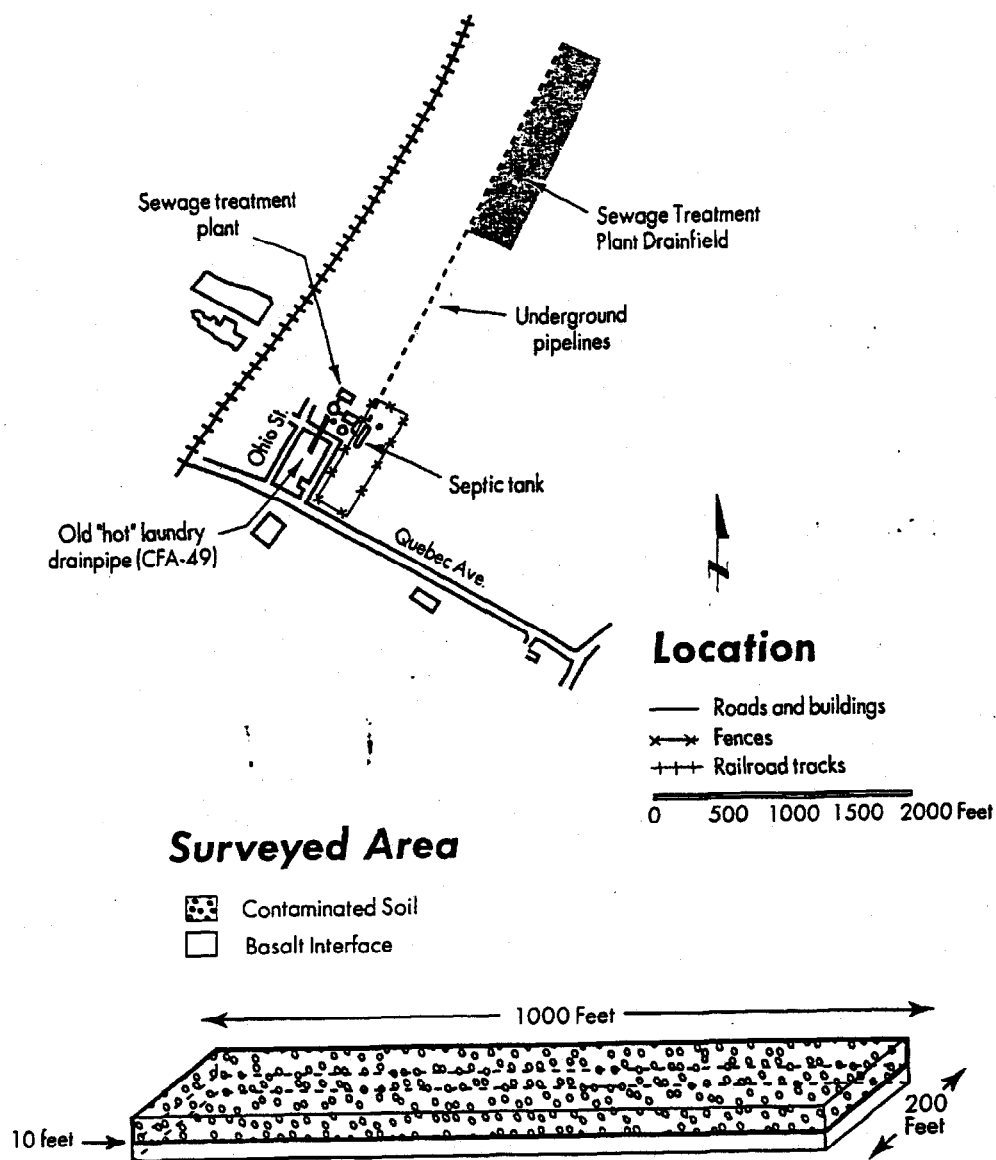
The CFA-08 site comprises three components in the FFA/CO (DOE-ID 1991): the SP building (CFA-691), the septic tank inside the SP (CFA-716) and the drainfield (Figure 8-2). Potential releases from the SP, the septic tank and associated piping/pipelines were investigated during decontamination and dismantlement activities that commenced in 1996. Those data were evaluated in the BRA portion of the OU 4-13 RI/FS (DOE-ID 1999a). The BRA concluded that concentrations of metals, radionuclides, herbicides, PCBs, volatile organic compound (VOCs), and SVOCs at the SP and the pipeline between the SP and the drainfield do not pose an unacceptable risk to human health and the environment. Those portions of the CFA-08 site require no further action.

The CFA-08 drainfield is approximately 61 × 305 m (200 × 1000 ft) with linear trenches that are approximately 1.8 m (6 ft) deep. It contains five distribution areas, each with 20 concrete drain pipes approximately 1.1 m (3.5 ft) bgs. The distribution pipes are surrounded by screened gravel in linear trenches 0.76 m (2.5 ft) wide, 1.8 m (6 ft) deep, and 61 m (200 ft) long. Basalt bedrock is encountered between 20 and 32 ft bgs in the vicinity of the drainfield. A sedimentary interbed was encountered at depths of approximately 102 ft bgs in two borings drilled adjacent to the drainfield (INEEL 1995c).

8.2.1 Site Investigations

The 1993 Track 2 investigation focused only on delineating potential releases from the drainfield because the SP, septic tank, and associated building piping were to be addressed under Decontamination and Deactivation activities (INEEL 1995d). Soil samples were collected from eight borings inside the drainfield, two borings outside the drainfield, and the Naval sludge drying bed. Perched water samples were obtained from two shallow wells within the drainfield and one well outside the drainfield at 102 ft bgs. Additionally, a radiological survey was performed over the soil surface downwind of the drainfield. Soil and water samples were analyzed for Contract Lab Program metals, VOCs, semi-volatile organic compounds, PCBs, tritium, and alpha, beta, and gamma-emitting radionuclides.

Concentrations of contaminants detected in the Naval sludge drying bed do not pose an unacceptable risk to human health or the environment. No windblown radiologic contamination above background levels was detected in surface soils downwind of the drainfield. Low levels of arsenic, barium, manganese, zinc and radionuclides were detected in the perched water samples. However, the perched water zones dissipated shortly after the SP ceased operation in 1995 (DOE-ID 1999a). The Track 2 preliminary scoping identified the following contaminants of concern for the CFA-08 drainfield: aroclor-1254, aroclor-1260, beryllium, cobalt-60, cesium-137, europium-152, europium-154, U-234, U-238, and Pu-239/240.



Site OU 4-08, CFA-08 Sewage Treatment Plant Drainfield

Figure 8-2. Sewage Plant Drainfield (CFA-08).

The OU 4-13 RI/FS investigation at the CFA-08 drainfield focused on collecting additional soil samples inside the drainfield and determining the lateral extent of contamination outside of the drainfield. The contaminant screening process retained aroclor-1254, cesium-137, Pu-239/240, and U-235 for evaluation of human health risks in the BRA.

8.2.2 Nature and Extent of Contamination

The nature and extent of contamination was estimated in the OU 4-13 RI/FS to be defined by the perimeter of the drainfield and estimated to be to a depth of 3.1 m (10 ft) bgs. The total volume is approximately 56,577 m³ (74,000 yd³).

8.2.3 Summary of Site Risks

The CFA-08 drainfield was retained for quantitative risk analysis in the BRA to evaluate human health risks from aroclor-1254, cesium-137, plutonium-239/240, and uranium-235. Ecological risks were evaluated for chloromethane, chromium-III, copper, lead, mercury, nickel, selenium, aroclor-1254, benzo(a)pyrene, and silver. Please refer to the OU 4-13 RI/FS (DOE 1999a) for the details of the risk assessment process. Refer to the OU 4-13 RI/FS (DOE 1999a) for the details of the risk assessment process.

8.2.3.1 Human Health Risk Assessment. Cesium-137 is the only contaminant at the CFA-08 drainfield that poses an unacceptable risk to human health. The maximum concentration of cesium-137 is 180 pCi/g and the exposure route is external exposure. Table 8-2 summarizes the cesium-137 data.

The total excess cancer risk for the current occupational work is 2E-03 (2 in 1,000). The majority of this risk (99%) is from external exposure to radiation from cesium-137 in soil. The noncarcinogenic hazard index is less than 1.

The total excess cancer risk for the future occupational work is 2E-04 (2 in 10,000). The major contributor is external exposure to radiation from cesium-137 in soil. The noncarcinogenic hazard index is less than 1.

The total excess cancer risk for the future residential scenario is 4E-04 (4 in 10,000). The majority of the risk (99%) is attributable to external radiation exposure to cesium-137 in soil. The noncarcinogenic hazard index is less than 1.

8.2.3.2 Ecological Risk Assessment. The ecological risk assessment determined that no contaminants pose an unacceptable risk to ecological receptors.

Table 8-2. Summary of data for human health COC at the CFA-08 drainfield.

Contaminant of Concern	Units	Number of Samples	Number of Detections	Minimum detected	Maximum detected	Exposure Point Concentration	INEEL Background Concentration ^a
Human Health							
Cesium-137	pCi/g	65	47	0.08	180	88.9 ^b	1.28
a. The background value for composited samples (INEEL 1996a).							
b. Volume weighted average 95% UCL concentration.							

8.3 CFA-10 Transformer Yard (OU 4-09)

The CFA-10 site will be remediated to address the threat to human health and ecological receptors posed by lead-contaminated soil. A summary of the site investigations, nature and extent of contamination, and estimated risks are presented below.

The Transformer Yard site (see Figure 8-3) is an area approximately 19.8m × 42 m. The building and yard area were used for welding and metalworking between approximately 1958 and 1985 (INEEL 1996a). From 1985 to 1990, electrical transformers were stored on the concrete pad. Process knowledge indicates that the yard was not used for waste disposal, but accidental spills may have occurred at the site. Potential contaminants were identified as metals and PCBs in the Track 2 scoping process.

8.3.1 Site Investigations

The CFA-10 Transformer Yard site was identified as a Track 2 investigation site in the FFA/CO (DOE-ID 1991). Six surface soil samples were collected in the Track 2 investigation for PCB analyses and four samples were analyzed for metals. Two of seven possible PCBs were detected: aroclor-1254 and aroclor-1260 with maximum concentrations of 1.4 and 1.3 mg/kg, respectively. The Track 2 investigation identified arsenic, lead, aroclor-1254 and aroclor-1260 as COPCs, and the site was carried forward to the OU 4-13 RI/FS.

As part of the OU 4-13 RI/FS investigation, soil samples were collected at four additional locations for lead analyses. At each location, samples were collected at the surface and at depths of 0.3 m (1 ft) and 0.6 m (2 ft) bgs. The average lead concentration for the surface soil, soil at 0.3 m (1 ft) bgs, and soil at 0.6 m (2 ft) bgs is 1,848, 64, and 18 mg/kg, respectively. Only the average lead concentration for the surface soil exceeds the EPA residential lead screening level of 400 mg/kg. Additionally, samples collected from the three depths at the four locations were analyzed by the TCLP for lead; two samples exceeded the toxicity characteristic level for lead. Aroclor-1254 and aroclor-1260 were retained for evaluation of human health risk; lead was evaluated against the EPA screening criterion.

8.3.2 Nature and Extent of Contamination

The extent of contamination at the CFA-10 Transformer Yard encompasses the dimensions of the yard to a depth of 0.15 m (0.5 ft). The volume of lead-contaminated soil is estimated to be 123 m³ (160 yd³). Subsurface data indicate that lead concentrations above 400 mg/kg are confined to the upper 0.15 m (0.5 ft) of the yard.

8.3.3 Summary of Site Risks

Because there are no toxicity data for lead, lead concentrations were compared to the EPA screening criterion. Aroclor-1254 and aroclor-1260 were evaluated for potential risk to human health in the BRA. Antimony, arsenic, cadmium, chromium III, cobalt, copper, lead, manganese, mercury, nickel, zinc, and aroclor-1254 were evaluated for potential risks to ecological receptors. Please refer to the OU 4-13 RI/FS for the details of the risk assessment process.

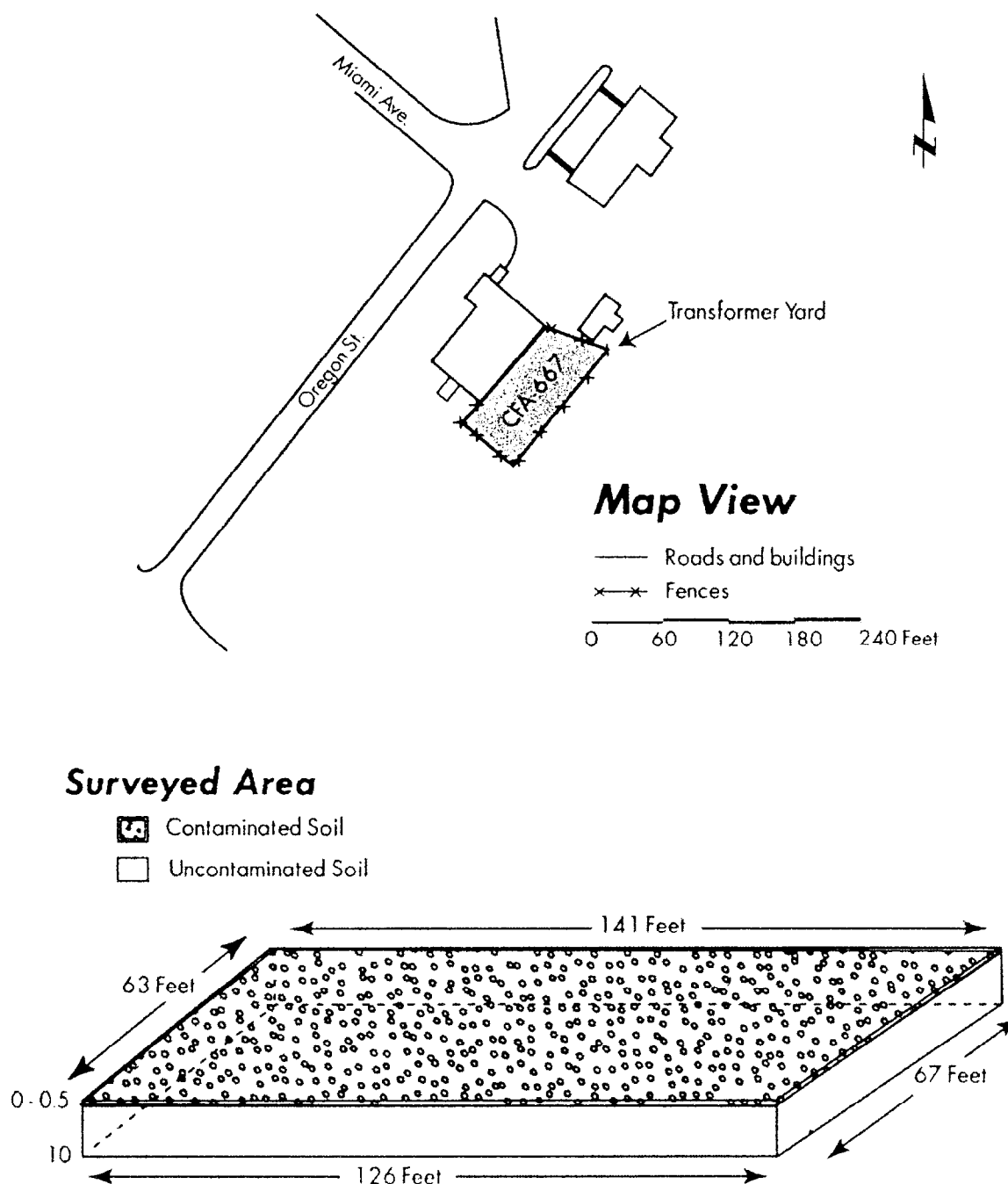


Figure 8-3. The Transformer Yard (CFA-10).

8.3.3.1 Human Health Risk Assessment. Lead is the only contaminant that poses an unacceptable risk to human health at CFA-10. Concentrations in the top 0.5 ft of soil exceed the EPA residential screening level of 400 mg/kg. Lead also poses an unacceptable ecological risk above 10 times background (170 mg/kg), in the top 0.15 m (0.5 ft) of soil. Data for lead at CFA-04 are summarized in Table 8-3.

The total excess cancer risk for the current and future occupational scenarios is less than 1E-04. The noncarcinogenic hazard quotient is less than 1 for both the current and future occupational scenarios.

8.3.3.2 Ecological Risk Assessment. Lead and copper were identified as a contaminant that poses unacceptable risks to ecological receptors at CFA-10. The exposure point concentration of 5,560 mg/kg for lead has a calculated hazard quotient of 5,000. The maximum copper concentration of 259 mg/kg is only slightly above the 10_x background criteria of 220 mg/kg in one sample of four detected samples. Data for lead and copper are summarized in Table 8-3.

Table 8-3. Summary of data for the human health and ecological COC at the CFA-10 Transformer Yard.

Contaminant of Concern	Units	Number of Samples	Number of Detections	Minimum Detected	Maximum Detected	Exposure Point Concentration	INEEL Background Concentration ^a
Human Health							
Lead	mg/kg	17	17	16.5	5,560	305 ^b	17
Ecological							
Lead	mg/kg	17	17	16.5	5,560 ^c	5,560	17
Copper ^c	mg/kg	4	4	36	259	259	22

a. The background value for composited samples from INEEL 1996a.

b. Volume weighted average 95% UCL concentration

c. Copper contamination was detected at the same depth of surface soil where lead contamination is and a remedial action for lead contamination is expected to also remediate the copper. Therefore, copper will not be evaluated further as a COPC in the FS..

9. REMEDIAL ACTION OBJECTIVES AND FINAL REMEDIATION GOALS

The remedial action objectives (RAOs) and final remediation goals (FRGs) for sites CFA-04, CFA-08, and CFA-10 are discussed below. The remedial alternatives were evaluated collectively in the Feasibility Study, and are presented similarly in this ROD. Sections 9 through 11 address the remedial alternatives for each of the three sites. The remedial alternatives, a comparison of these alternatives, and the selected remedies are presented.

9.1 Remedial Action Objectives

These RAOs are based on the results of both human health and ecological risk assessments and are specific to the COCs and exposure pathways for each of the three sites.

The RAOs were developed in accordance with the NCP and CERCLA RI/FS guidance (EPA 1988) and refined through discussions among the Agencies (IDHW, EPA Region 10, and DOE-ID). During development of the RAOs it was assumed that CFA would serve as the primary area at INEEL for technical service and support functions for the next 100 years with access restrictions and other administrative and physical security controls.

Based on these assumptions the RAOs are to:

- Prevent direct exposure to radionuclide COCs that would result in a total excess cancer risk greater than 1 in 10,000
- Prevent ingestion and inhalation of radionuclide and nonradionuclide COCs that would result in a total excess cancer risk greater than 1 in 10,000, or a total of hazard index greater than 1.0
- Prevent exposure to lead at concentrations over 400 mg/kg, the EPA residential screening level for lead
- Prevent exposure of ecological receptors to contaminated soil with concentrations greater than or equal to a screening level of 10 times background values that result in a hazard quotient greater than or equal to 10.
- Monitor the groundwater at WAG 4 until the nitrate level falls below the MCL of 10 mg/L.

9.2 Final Remediation Goals for the Selected Alternatives

The FRGs developed in the OU 4-13 RI/FS (DOE-ID 1999a) are based on risk-specific doses, applicable or relevant and appropriate requirements (ARARs), or EPA guidance and are summarized in Table 9-1. For sites, CFA-04 and CFA-10, the FRGs are based on screening level goals rather than further intensive analysis and the additional cost of further study, which would be necessary to refine the FRGs.

Table 9-1. Final Remediation Goals for sites with selected alternatives.

Site	Contaminant	FRG	Basis
CFA-04 Pond	Mercury	0.50 mg/kg	Ecological goal based on ten times average background concentration for composited samples. ^a
CFA-08 Sewage Plant Drainfield	Cesium-137	2.3 pCi/g ^b	Human health goal. See Footnote b.
CFA-10 Transformer Yard	Lead	400 mg/kg	EPA residential screening level (400 mg/kg)

a. Ecological goal is lower than human health goal of 1.27 mg/kg.

b. The maximum cesium-137 concentration at the CFA-08 drainfield (180 pCi/g) will naturally decay to 23 pCi/g in the 100-year IC period for the INEEL. However, the ultimate goal for unrestricted access is 2.3 pCi/g, the 1E-04 future residential risk-based concentration. That concentration will be achieved in an additional 89 years through continued natural decay. Note that 23 pCi/g is not a true "remediation goal" in that soil is not being removed to this level; it will be achieved through radioactive decay. Confirmatory soil sampling to demonstrate that this level is achieved in 100 years will not be performed under this remedy, because the known radioactive half-life for cesium-137 is 30 years (Benedict et al. 1981).

10. DESCRIPTION OF ALTERNATIVES

The alternatives listed below were developed to meet the RAOs for contaminated materials at sites CFA-04, -08, and -10.

1. No Action (with monitoring)
2. Limited Action
3. Excavation, treatment by stabilization, and disposal
 - a. On-INEEL disposal
 - b. Off-INEEL disposal
4. Containment.

A brief description of each alternative is presented in the sections below.

10.1 Alternative 1—No Action (With Monitoring)

The NCP [40 CFR 300.430(e)(6)] requires consideration of a No Action alternative to serve as a baseline for evaluation of other remedial alternatives. The primary elements of Alternative 1 are:

- No remedial actions would be taken.
- No land-use restriction, controls, or active remedial measures would be implemented at the site.
- Environmental monitoring may be warranted if contamination is left in place under this alternative. Monitoring would enable detection of contaminant migration within environmental media (air, groundwater, and soil) or other changes in site conditions that warrant future remedial actions. Monitoring would remain in effect for at least 100 years. For the sites in this ROD, environmental monitoring would consist of radiological surveys in appropriate areas, groundwater, and air monitoring. Any required air monitoring would be performed as part of the INEEL air-monitoring program. The frequency and locations of all air monitoring activities would be determined during the remedial design.

10.2 Alternative 2—Limited Action

A Limited Action alternative was developed that consists of:

- Institutional controls (ICs) include property transfer restrictions in perpetuity. These restrictions would limit use of property if it is transferred from government control to private ownership. If the property is ever transferred to private ownership, the information required under Section 120(h) of CERCLA would be transferred with it. The property transfer documentation would provide notification to the new property owner disclosing former waste management and disposal activities that occurred on the site. It would limit property use to activities that would prevent human health risks from exceeding allowable levels. These restrictions may take the form of restrictive covenants or easements established in perpetuity.

- Access restrictions would be maintained during the institutional control period using fences and signs. Routine site inspections and monitoring for animal burrows, erosion, or subsidence also will be performed to assess maintenance requirements.
- Surface water would be controlled to minimize the potential for surface water accumulation at the site. This management would include inspection and maintenance of site drainage.
- Environmental monitoring may be warranted if contamination is left in place under this alternative. Monitoring would enable detection of contaminant migration within environmental media (air, groundwater, and soil) or other changes in site conditions that warrant future remedial actions. Monitoring would remain in effect for at least 100 years. For the sites in this ROD, environmental monitoring would consist of radiological surveys in appropriate areas and groundwater monitoring. Any required air monitoring would be performed as part of the INEEL air-monitoring program. The frequency and locations of all air monitoring activities would be determined during the remedial design.

10.3 Alternative 3—Excavation, Treatment, and Disposal

Remedial alternatives incorporating treatment were developed to meet ARARs and EPA's preference for treatment. Treatment may be required to dispose contaminated media removed from a site. Alternatives incorporating treatment were developed to allow risk managers to determine the relative cost-effectiveness and practicability. Excavation, treatment, and disposal alternatives could be applied to any of the three remediation sites.

10.3.1 Alternative 3a—Excavation, On-INEEL Treatment, and Disposal

CFA-04. This alternative would consist of the actions listed below. No ICs would be required for the CFA-04 Pond after completing the remediation, providing soil exceeding the FRG is removed.

- Characterizing the site and excavating soil and sediments from the pond exceeding FRG. Soil contaminated at concentrations above the FRG will be excavated to a maximum depth of 3 m (10 ft) bgs or to basalt. No basalt will be excavated.
- Transporting excavated soil exceeding the FRG to the ICDF.
- Stabilizing soil exceeding the RCRA characteristic hazardous waste levels for mercury with cement.
- Disposing treated and nontreated soil at the ICDF.
- Performing verification sampling to ensure that there is no identified contamination remaining at the site exceeding the FRG.
- Backfilling the pond and any adjacent excavations with uncontaminated soil to grade. All excavations will be contoured to match the surrounding terrain and revegetated.

CFA-08. This alternative would consist of the actions listed below. No ICs are necessary at CFA-08 provided that soil exceeding the FRG is removed from the site. Note that in this instance the FRG for excavation would be 2.3 pCi/g for cesium-137; that concentration is the 1E-04 risk-based concentration for the future residential scenario for unrestricted access.

- Characterizing soil and excavating soil and sediments from the drainfield exceeding FRG. Soil contaminated at concentrations above the FRG will be excavated to a maximum depth of 3 m (10 ft) bgs or to basalt. No basalt will be excavated.
- Allowing sludges remaining in drainfield feeder lines to drain into soil during excavation.
- Transporting soil exceeding the FRG to the ICDF
- Performing verification sampling to ensure that there is no identified contamination remaining at the site exceeding the FRG.
- Returning soil contaminated at less than FRG to the excavation.
- Backfilling the excavation with uncontaminated native soil, creating final slopes that will divert water, and revegetating the site.

This alternative originally used soil separation as the treatment technology. However, a pilot-scale treatability study performed by WAG 5 in 1999 (INEEL 1999) concluded that this technology is not cost effective for this type of soil contamination. Therefore, soil separation was eliminated from the alternative. Soil excavated that exceeds the FRG would be disposed of at the ICDF.

CFA-10. This alternative would consist of the actions listed below. No ICs are necessary at CFA-10 provided that soil exceeding the FRG is removed from the site.

- Characterizing soil and excavating soil exceeding FRG. Soil contaminated at concentrations above the FRG will be excavated to a maximum depth of 3 m (10 ft) bgs or to basalt. No basalt will be excavated.
- Performing verification sampling to ensure that there is no identified contamination remaining at the site exceeding the FRG.
- Transporting soil contaminated above the FRG to the ICDF.
- Stabilizing soil that exhibits the RCRA toxicity characteristic for lead, and disposing of treated and nontreated soils to the ICDF.
- Returning soil contaminated at less than the FRG to the excavation.
- Backfilling the excavation with uncontaminated soil to grade. The excavation will be contoured to match the surrounding terrain and revegetated.

10.3.2 Alternative 3b—Excavation, Treatment, and Disposal Off-INEEL

CFA-04. This alternative would consist of the actions described in Section 10.3.1, Alternative 3a, for this site, except that soils exceeding the FRG would be treated, transported to, and disposed of at an off-INEEL TSDF.

CFA-08. This alternative would consist of the actions listed in Section 10.3.1, Alternative 3a, for this site, except that soils contaminated at levels exceeding the FRG would be transported to an off-INEEL low-level waste landfill for disposal.

CFA-10. This alternative would consist of the actions described in Section 10.3.1, Alternative 3a, for this site, except that soils exceeding the FRGs would be treated, transported to, and disposed of at an off-INEEL TSDF.

10.4 Alternative 4—Containment and Institutional Controls

The alternatives developed for containing contamination are based on capping technologies. These alternatives would be designed to meet RAOs by eliminating exposure pathways identified in the BRA. The cap must be designed to maintain integrity for the period of time that unacceptable exposure risks will be present. The functional life of a particular cover is dependent on how long failure mechanisms such as erosion, subsidence, geosynthetic failure, infiltration, biotic and human intrusion can be delayed. The human health risks due to cesium-137 contamination at CFA-08 will decline to acceptable levels for unrestricted access within 189 years through natural radioactive decay. Human health and ecological risks due to toxic metals at CFA-04 and -10 will not decrease due to time.

For CFA-04 and CFA-10, the cap would also be required to meet RCRA 40 CFR 264.310 (a)(1-5), which would be an ARAR for those sites. This regulation specifies that the cap must meet the following functional requirements:

- Provide long-term minimization of infiltration
- Function with minimum maintenance
- Promote drainage and minimize erosion or abrasion of the cover
- Accommodate settling and subsidence so that the cover's integrity is maintained
- Maintain permeability less than or equal to the permeability of any bottom liner system or natural subsoil present.

An engineered C-ET barrier was determined to best meet the functional requirements and was selected as the representative capping technology for Alternative 4 for all three.

Institutional controls, as described for Alternative 2, would be implemented. The cap would be maintained during the entire 100-year IC period. Long-term maintenance and inspection requirements would include reestablishing vegetation as necessary, repairing any subsidence, erosion furrows and animal burrows, and removing undesirable plants. Long-term monitoring requirements would include visual inspections and radiation surveys.

11. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The alternatives discussed in Section 10 were evaluated for each site using the nine evaluation criteria required under CERCLA (40 CFR 300.430[f][5][I]). The purpose of these comparisons is to identify the relative advantages and disadvantages of each alternative. Each criterion is described below and the alternatives are presented in decreasing order from the most to least advantageous. Table 11-1 provides a summary of the evaluation criteria for the alternatives and a ranking of alternatives for each criterion and each site.

11.1 Threshold Criteria

The selected remedial action must meet the threshold criteria of overall protection of human health and the environment, and compliance with ARARs.

11.1.1 Overall Protection of Human Health and the Environment

This criterion addresses the degree to which a remedy provides adequate protection of human health and the environment. Risks posed by the COCs at the site may be eliminated, reduced, or controlled through removal, treatment, engineering controls, or ICs. Long-term risk calculations in the BRA and short-term health effects associated with construction work in the field must be considered for this criterion.

- Alternatives 3a and 3b are the most protective, since contaminated soil above FRGs would be removed from WAG 4.
- Alternative 4 meets human health and ecological RAOs; however, it is less effective than Alternatives 3a and 3b, since contamination would remain at the sites. Mercury and lead would remain indefinitely at CFA-04 and CFA-10, respectively, while cesium-137 at CFA-08 would decay to allowable residential levels within 189 years.
- Alternative 2 does not meet the criterion at CFA-04, CFA-08, or CFA-10. Contamination remaining at CFA-04 and CFA-10 would exceed human health remediation goals. Contamination remaining at CFA-08 after 100 years of institutional control would exceed the human health unrestricted release criterion of 2.3 pCi/g cesium-137.
- Alternative 1 does not satisfy the criterion for any of these three sites, because site access and contact with the contaminated media are not prevented, and potential risks are not reduced. The no action alternative does not meet RAOs for protection of human health and the environment.

Table 11-1. Relative ranking of alternatives evaluated for the three WAG 4 OU 4-13 sites of concern.^a

Evaluation Criteria	CFA-08	CFA-04	CFA-10
Overall protection of human health and the environment	(3b, 3a), 4 1 and 2 do not meet the criterion.	(3a, 3b), 4 1 and 2 do not meet the criterion.	(3a, 3b), 4 1 and 2 do not meet the criterion.
Compliance with ARARs	(3a, 3b, 4) 1 and 2 do not meet the criterion.	(3a, 3b, 4) 1 and 2 do not meet the criterion.	(3a, 3b, 4) 1 and 2 do not meet the criterion.
Long-term effectiveness and permanence	(3a, 3b), 4	(3a, 3b), 4	(3a, 3b), 4
Reduction of toxicity, mobility or volume through treatment	(3a, 3b), 4	(3a, 3b), 4	(3a, 3b), 4
Short-term effectiveness	4, (3a, 3b)	4, (3a, 3b)	4, (3a, 3b)
Implementability	4, 3b, 3a	4, 3b, 3a	4, 3b, 3a
Cost	4, 3a, 3b	3a, 4, 3b	3a, 3b, 4

a. Ranking is from highest to lowest, except for costs, which are ranked from lowest to highest in net present value.

() = No significant difference between alternatives with respect to the criterion.

Alternative 1: No Action with monitoring.

Alternative 2: Institutional Controls.

Alternative 3a: Excavate, Treat, and ICDF Disposal

Alternative 3b: Excavate, Treat and Off-INEEL TSDF Disposal

Alternative 4: Containment with an engineered cover and Institutional Controls.

11.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Evaluation of compliance with ARARs for all alternatives is included in Table 11-1 and summarized below. A complete list of ARARs for selected remedies are provided in Section 13, Table 13-1.

- Alternatives 3a, 3b, and 4 meet all ARARs identified in Section 13, Table 13-1 for CFA-04, CFA-08, and CFA-10.
- The RAOs for CFA-04 and CFA-08 would be met under Alternative 4 since contaminated soil would be capped and the exposure pathway eliminated. The engineered cover would meet the to-be-considered (TBC) requirements of DOE orders for low-level waste disposal for CFA-08 and would meet RCRA Subtitle C requirements of cap performance for CFA-04 and CFA-10.

- Alternative 2 would not meet (DOE Order 5400.5) for a period of 89 years after the 100-year institutional control period at CFA-08. Because hazardous constituents would be left in place, Alternative 2 would not meet RCRA Subtitle C standards for landfill closure and post-closure at CFA-04 and CFA-10.
- Alternative 1 would not meet (DOE Order 5400.5) for 189 years at CFA-08. Alternative 1 would not meet RCRA Subtitle C standards for landfill closure and post-closure at CFA-04 and CFA-10.

11.2 Balancing Criteria

The balancing criteria used in refining the selection of the candidate alternatives for the site include: (1) long-term effectiveness and permanence; (2) reduction in toxicity, mobility, or volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost. Only alternatives 3a, 3b, and 4 are evaluated against balancing criteria because 1 and 2 do not fulfill the threshold criteria.

11.2.1 Long-Term Effectiveness and Permanence

This criterion includes consideration of residual risk that will remain on-INEEL following remedial action. The adequacy and reliability of controls are also considered.

- Alternatives 3a and 3b would achieve the highest level of long-term effectiveness and permanence because contaminated soil and debris would be completely removed from the sites. Solid waste generated would be managed in accordance with ARARs. The ICDF will be required to meet substantive requirements for a TSDF under the Hazardous Waste Management Act and RCRA. Institutional controls would ensure effectiveness of the remedy at any site where contaminated soil above FRGs was allowed to remain below 3 m (10 ft) bgs.
- Alternative 4 would be highly effective at achieving long-term effectiveness and permanence at CFA-08. The effectiveness of the containment option is greater at the CFA-08 Drainfield than at CFA-04 and CFA-10 because the cap integrity needs to be maintained for a shorter period due to the radioactive decay of the COC. External exposure risks estimated for the CFA-08 drainfield, due to cesium-137, decrease to 1E-04 in approximately 189 years. However, human health and ecological risks from toxic metals at CFA-04 and CFA-10 would not decrease with time. Under Alternative 4, long-term effectiveness and permanence at CFA-04 and CFA-10 depends on the durability of the cap. Cap integrity monitoring, as well as periodic removal of undesirable vegetation and burrowing animals (if necessary), would be performed.

11.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently result in reduction of toxicity, mobility, or volume of the hazardous substances as their principal elements.

- No reduction in toxicity or volume would result from stabilization (Alternative 3) of mercury- or lead-contaminated soils at CFA-04 and CFA-10, respectively. Volume increase would likely be in the range of 200%. The overall mobility of lead and mercury would be reduced through stabilization.

- No reduction in volume through treatment would occur for Alternatives 3a and 3b for site CFA-08. These alternatives, as presented in the Proposed Plan (DOE-ID 1999b), incorporated treatment by segmented gate separation (SGS) of cesium-137 contamination. Application of this treatment at WAG 4 was contingent on acceptable results in a WAG 5 treatability study that investigated the viability of SGS on INEEL soils. The results of this study indicate that the radiological components in contaminated soil could not be effectively separated (INEEL 1999). The SGS system is, therefore, not considered further for CFA-08 for either of these alternatives.
- Alternative 4 does not include treatment.

11.2.3 Short-Term Effectiveness

The short-term effectiveness criterion addresses the time needed to implement remedies to reduce any adverse impacts on human health and the environment. This criterion specifically refers to risks that may be posed during the construction and implementation period of remedial action prior to achieving remedial goals. For this criterion, the alternative that provides the least amount of disturbance to contaminated materials ranks the highest in terms of short-term effectiveness because of the potential for worker exposure.

- Alternatives 3a and 3b provide a moderate degree of short-term effectiveness primarily due to potential worker exposure. Health risks to workers during excavation would be minimized to the extent possible. Potential exposures from removal and treatment of waste would be mitigated using standard administrative and engineering controls. These controls could include, but are not limited to dust suppression and appropriate personal protective equipment. Other measures may include the use of excavation equipment modified with positive-pressure ventilation systems and HEPA filters for use in contaminated areas. Environmental impacts for Alternatives 3a and 3b are minimal. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist at WAG 4.
- Alternative 4 also provides a moderate degree of short-term effectiveness primarily due to potential worker exposure. The possibility of direct radiation exposure of workers installing a protective cover at CFA-08 would be minimized by first placing a foundation layer over the contaminated soils. Emplacement of foundation material and the lowermost layer(s) of the cover would add additional shielding sufficient to eliminate subsequent exposure risks throughout the remainder of construction activities at CFA-08. Construction activities would be performed in accordance with the as low as reasonably achievable (ALARA) approach to radiation protection as required under (10 CFR 835). Inhalation and ingestion risks due to toxic metals in soil at CFA-04 and -10 would be minimized by the use of appropriate personal protective equipment, engineering controls, and adherence to health and safety protocols. Environmental impacts resulting from excavation and construction activities would be minimal.

11.2.4 Implementability

The implementability criterion addresses such factors as the availability of services and materials. Coordination with other governmental entities is also considered.

- The implementability of Alternative 3a for CFA-04, CFA-08, and CFA-10 is considered moderate. The technology to perform stabilization is readily implementable. Chemical

stabilization of lead and mercury has been previously performed at the INEEL. The moderate rating is primarily due to the uncertain availability of the ICDF, which is planned to begin operations in 2004.

- The implementability of Alternative 3b for site CFA-04 and -10 is considered high, due to the ready availability of an off-INEEL disposal facility. The technology associated with stabilization and disposal is also readily implementable. Off-INEEL disposal can be implemented sooner because the ICDF may not be complete for several years. The implementability of Alternative 3b for CFA-08 is high.
- Alternative 4 is highly implementable for all three sites due to the availability of materials and technology.

11.2.5 Cost

Table 11-2 presents a summary of the comparative costs of the alternatives for CFA-04, CFA-08, and CFA-10.

CFA-04. Of the three alternatives that meet the threshold criteria, the least costly alternative for CFA-04 is Alternative 3a, Excavation, Treatment and disposal at ICDF. Alternative 4 is the next lowest cost. The operating and maintenance costs for Alternative 4 account for approximately 40% of the overall costs. Alternative 3b has the highest cost, primarily due to the cost of shipping contaminated soils to an off-INEEL facility.

CFA-08. Of the three alternatives that meet the threshold criteria, the least costly alternative for CFA-08 is Alternative 4, Containment. Approximately 35% of this total cost is attributable to operating and maintenance costs. Alternative 3a has the next lowest cost. The increase in costs for 3a is due to the excavation of drainfield soils and on-INEEL disposal. The costs for Alternative 3b are highest due to the additional cost of off-INEEL transport and disposal.

CFA-10. Of the three alternatives that meet the threshold criteria, the least costly alternative for CFA-10 is Alternative 3a, Excavate, Treat, and disposal at the ICDF. Alternative 3b has the next lowest cost. The slightly higher cost of Alternative 3b in comparison to 3a is primarily due to the additional cost of off-INEEL transport and disposal. Alternative 4, containment, has the highest cost. Approximately 55% of these costs are attributed to long-term operations and maintenance of a cover.

11.3 Modifying Criteria

The modifying criteria—state and community acceptance—are used in the final evaluation of remedial alternatives. Consideration in evaluating state and community acceptance includes elements of the alternatives that are supported, unsupported, or strongly opposed.

11.3.1 State Acceptance

The IDHW has been involved in the development and review of the RI/FS report, the Proposed Plan, and this ROD. All comments received from IDHW have been resolved and incorporated into these documents. The IDHW has participated in public meetings where public comments and concerns have been voiced and responses offered.

The IDHW concurs with the selected remedial alternatives.

Table 11-2. Costs for the alternatives considered for CFA-04, CFA-08, and CFA-10.

	Alternative 1 No Action	Alternative 3a on-INEEL	Alternative 3b off-INEEL	Alternative 4 containment
CFA-04				
Capital cost	\$0.9	\$4.8	\$12.6	\$4.8
O & M cost	<u>0.2</u>	<u>N/A</u>	<u>0.2</u>	<u>3.1</u>
Total cost	\$1.1	\$4.8*	\$12.8	\$7.9
CFA-08				
Capital cost	\$0.9	\$30.8	\$36.5	\$7.3
O & M cost	<u>0.2</u>	<u>0.2</u>	<u>0.2</u>	<u>\$3.5</u>
Total cost	\$1.1	\$31.0	\$36.7	\$10.8
CFA-10				
Capital cost	\$0.8	\$1.3	\$1.4	\$2.1
O & M cost	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>2.7</u>
Total cost	\$0.8	\$1.3	\$1.4	\$4.8

Costs are in millions and net present value.

O&M costs are included in capital costs for CFA-10 alternatives 1, 3a and 3b.

N/A = Not Applicable.

* These costs are lower than the \$6.9M estimate presented in the Proposed Plan because the number of five-year reviews was reduced by one and ICDF disposal costs to be borne by WAG 3 have been removed (DOE-ID 2000d).

11.3.2 Community Acceptance

Community participation in the remedy selection process includes participation in the public meetings held in August, 1999, and review of the Proposed Plan during the public comment period that began August 5 and ended October 4, 1999. The highlights of community participation are included in Section 3. The Responsiveness Summary (Part III) includes verbal and written comments received from the public and the Agencies' responses to these comments.

Approximately 30 people not associated with the project attended the proposed plan public meetings. Overall, 12 people provided formal comments; of these, five people provided verbal comments, and seven provided written comments. All comments received on the Proposed Plan were considered during the development of this ROD.

In general, the public was supportive of the preferred alternatives for the three sites to be remediated at WAG 4. Two stakeholders questioned the need for cleanup and the cost estimates for the remedial projects. It was explained that the sites were selected on the basis of CERCLA cleanup criteria, and that costs will be refined as the projects progress through the RD/RA process. Please refer to the Responsiveness Summary in Part III for more details.